



# MIOS System to Monitor Activity and Environmental Conditions Inside Rodent Home-Cages

Christopher Roque<sup>1</sup>, Marcial Garmendia<sup>1</sup>, Jonathan Krynitsky<sup>1</sup>, Ghadi Salem<sup>1</sup>, Alexxai Kravitz<sup>2</sup>, Vlado Knezevic<sup>2</sup>, Mohamed Ali<sup>2</sup>, John Dennis<sup>3</sup>, Thomas Pohida<sup>1</sup>

<sup>1</sup>Center for Information Technology, <sup>2</sup>National Institute of Diabetes and Digestive and Kidney Diseases, <sup>3</sup>Food and Drug Administration



Winner of 2017 HHS Secretary's Ventures Fund

## Introduction

MIOS is a sensor-based system that monitors and analyzes the activity and environment of rodents in their home-cages during research studies. The cloud-based system helps researchers and scientists by facilitating data sharing, multi-site studies, and reproducible research. MIOS may reduce the costs and the need for time-consuming behavior assessments such as manually or video-based observations of laboratory animals. The system wirelessly uploads real-time data to a cloud-based server that provides mobile and web-based access for visualization and analytics. Potentially, the MIOS system improves the quality of care for lab rodents, significantly reduces costs, improves research reproducibility, and enables novel experiments.

## Behavior Assessment - Existing Methods/Limitations

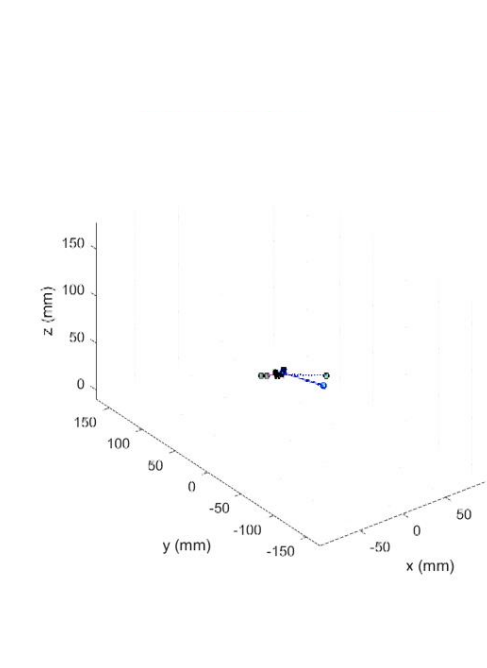
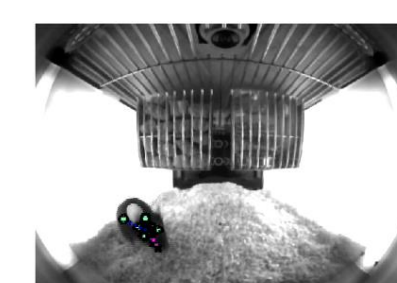
### Manual Observations

- Expensive
- Subjective
- Time Consuming



### Video-Based Automated Monitoring

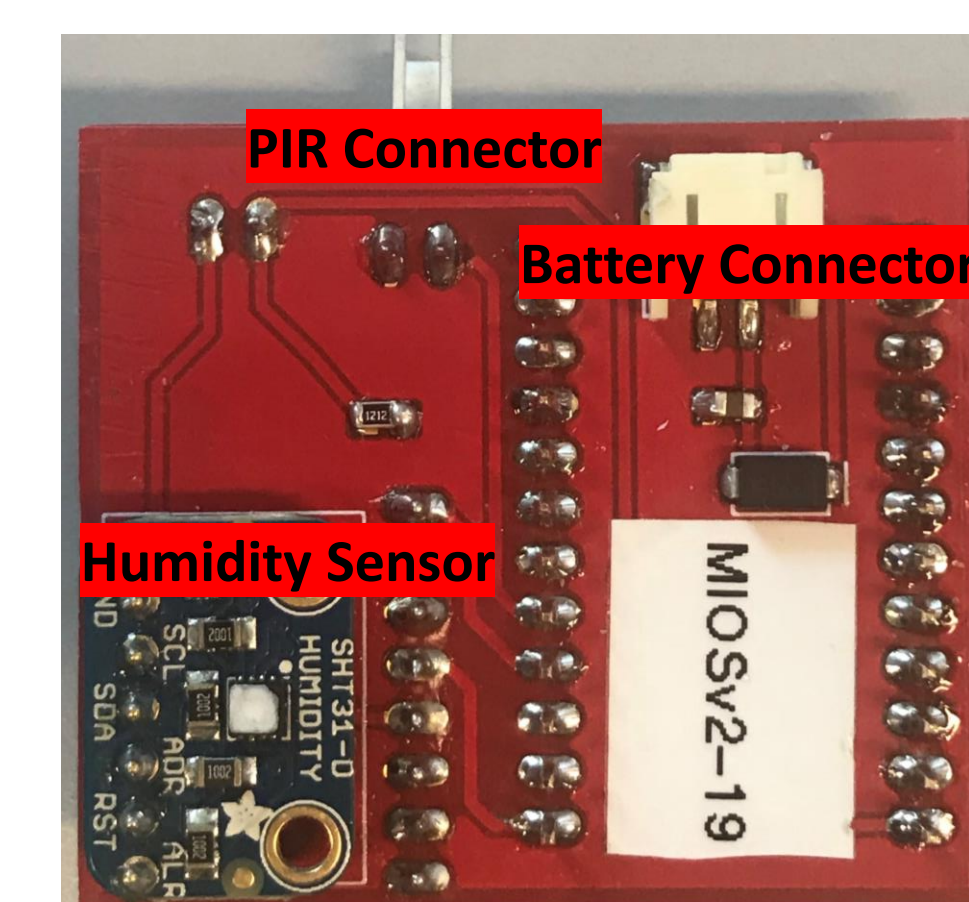
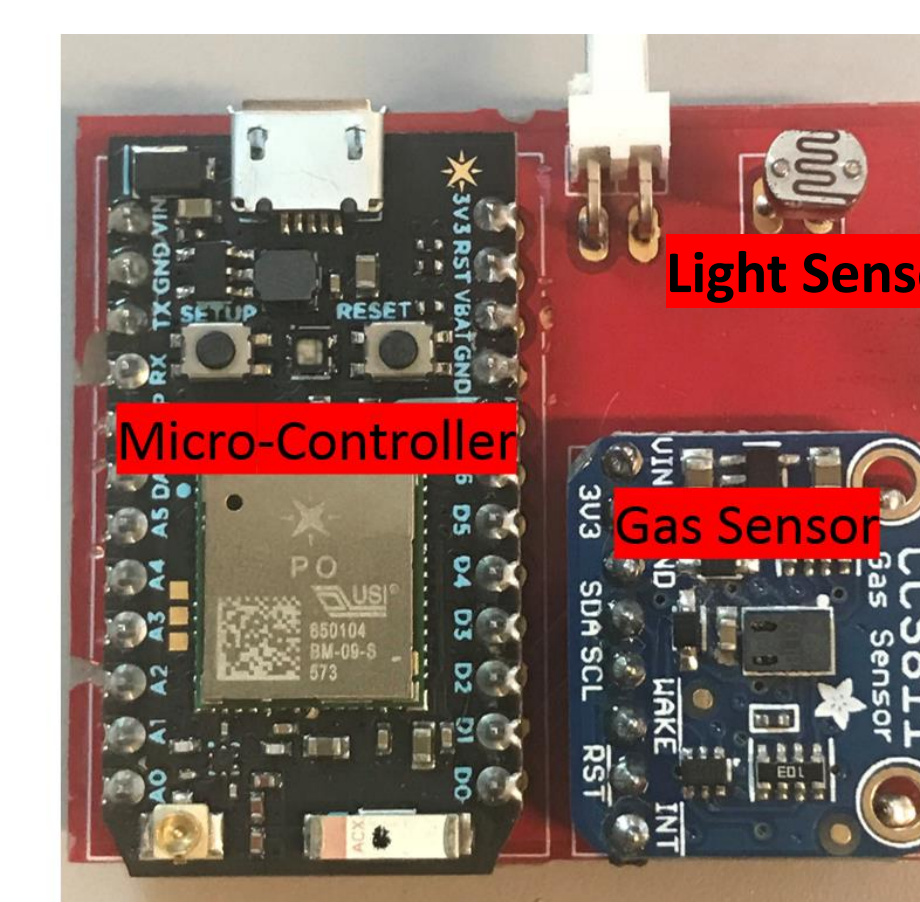
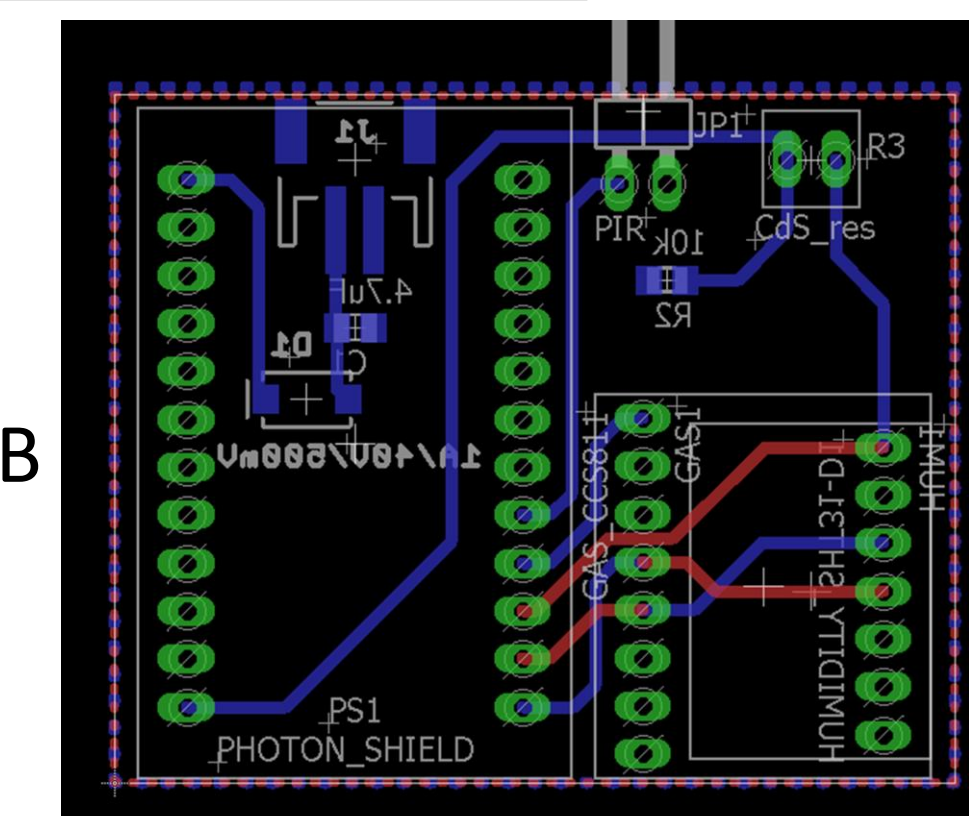
- Expensive
- Challenging
- Requires High Bandwidth
- Not Easily Scalable



## Proposed Circuit Design

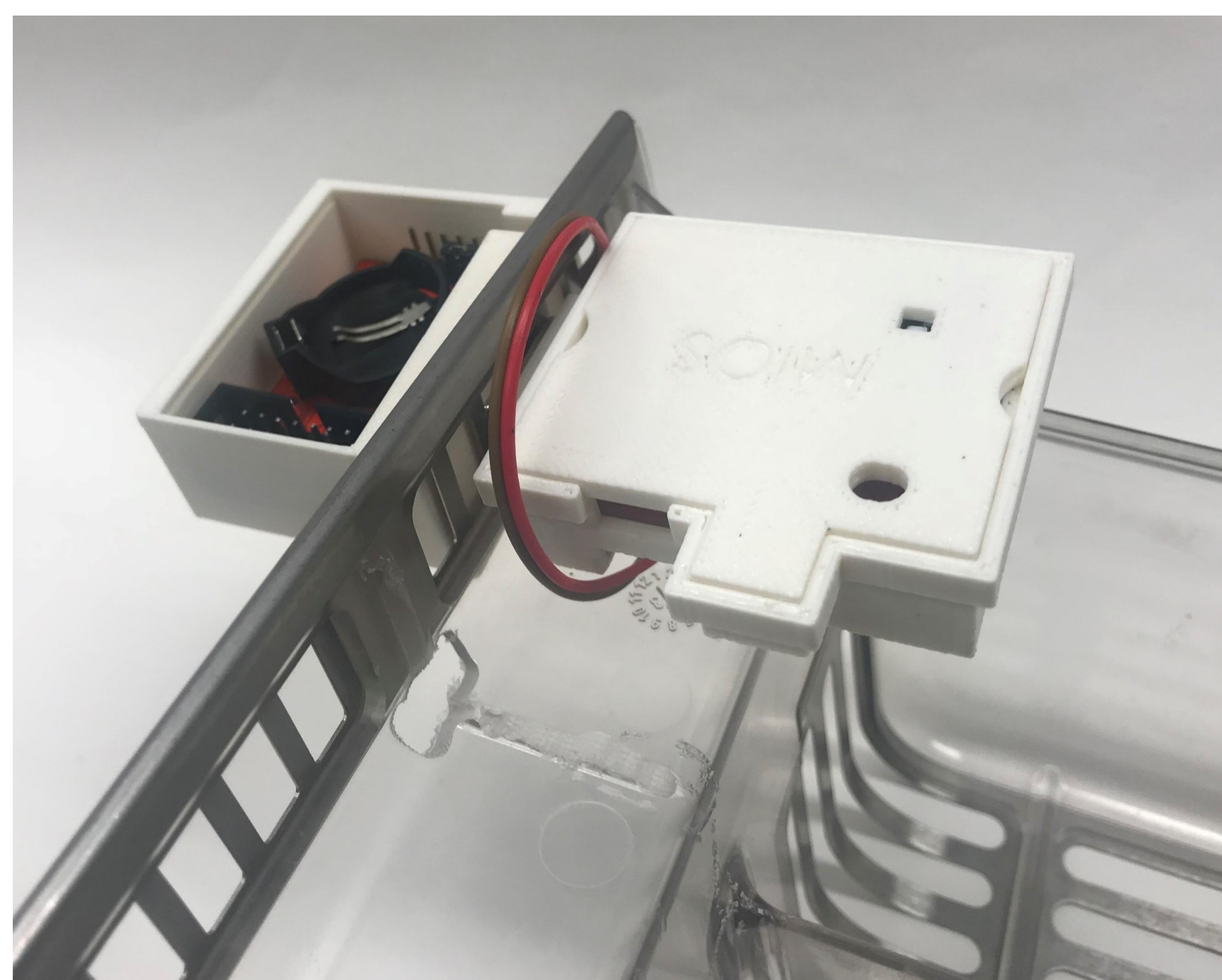
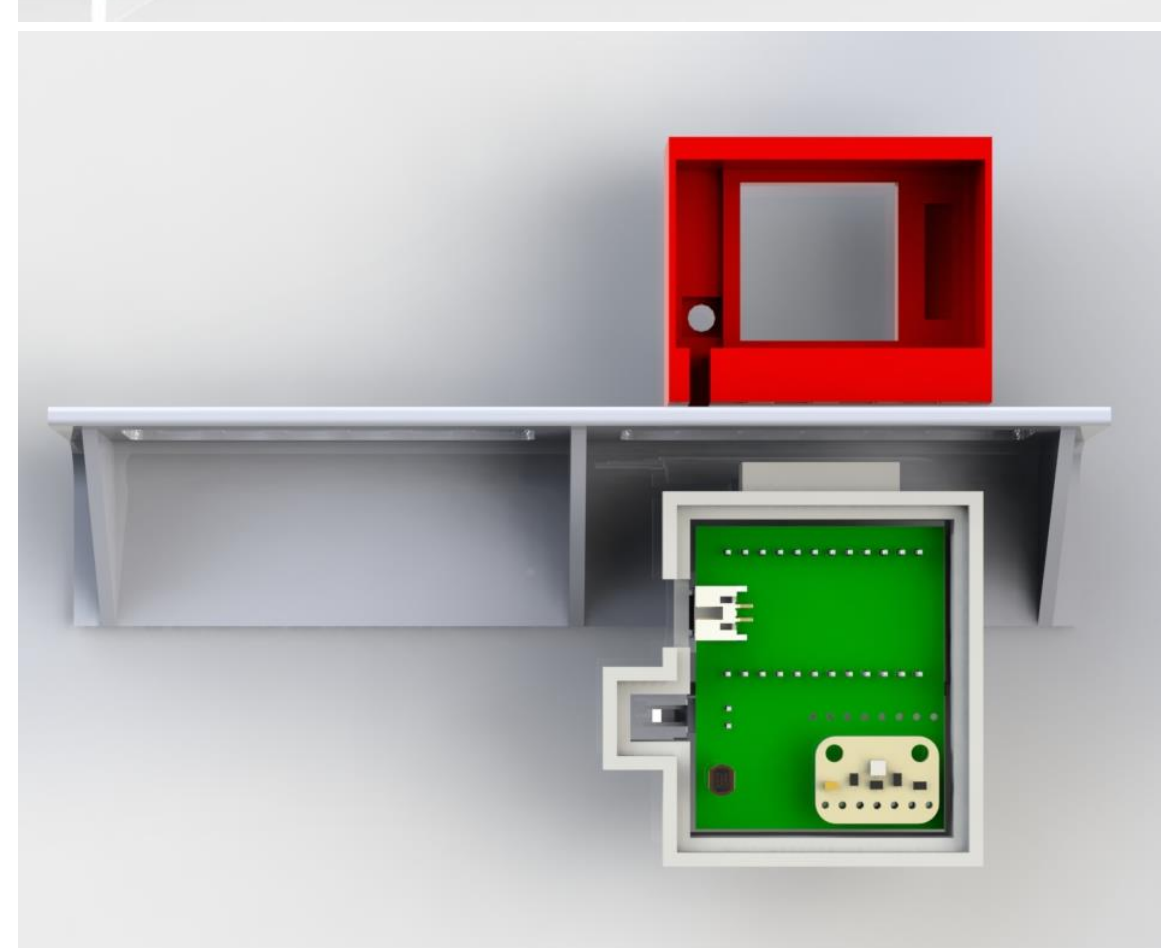
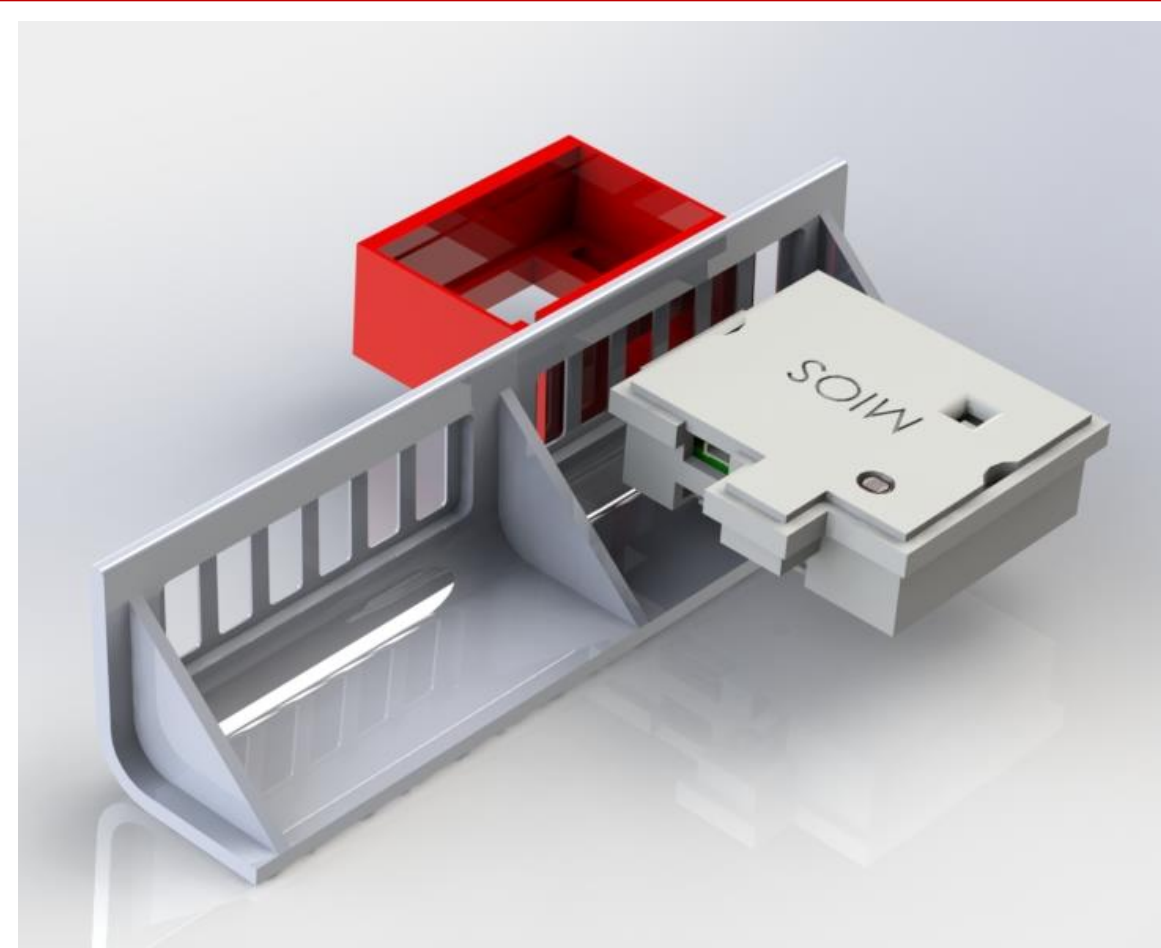
Designed a printed circuit board (PCB) to integrate sensors

- System mechanical parameters determined size and shape of PCB
- Durable double-sided PCB
- Plug and Play



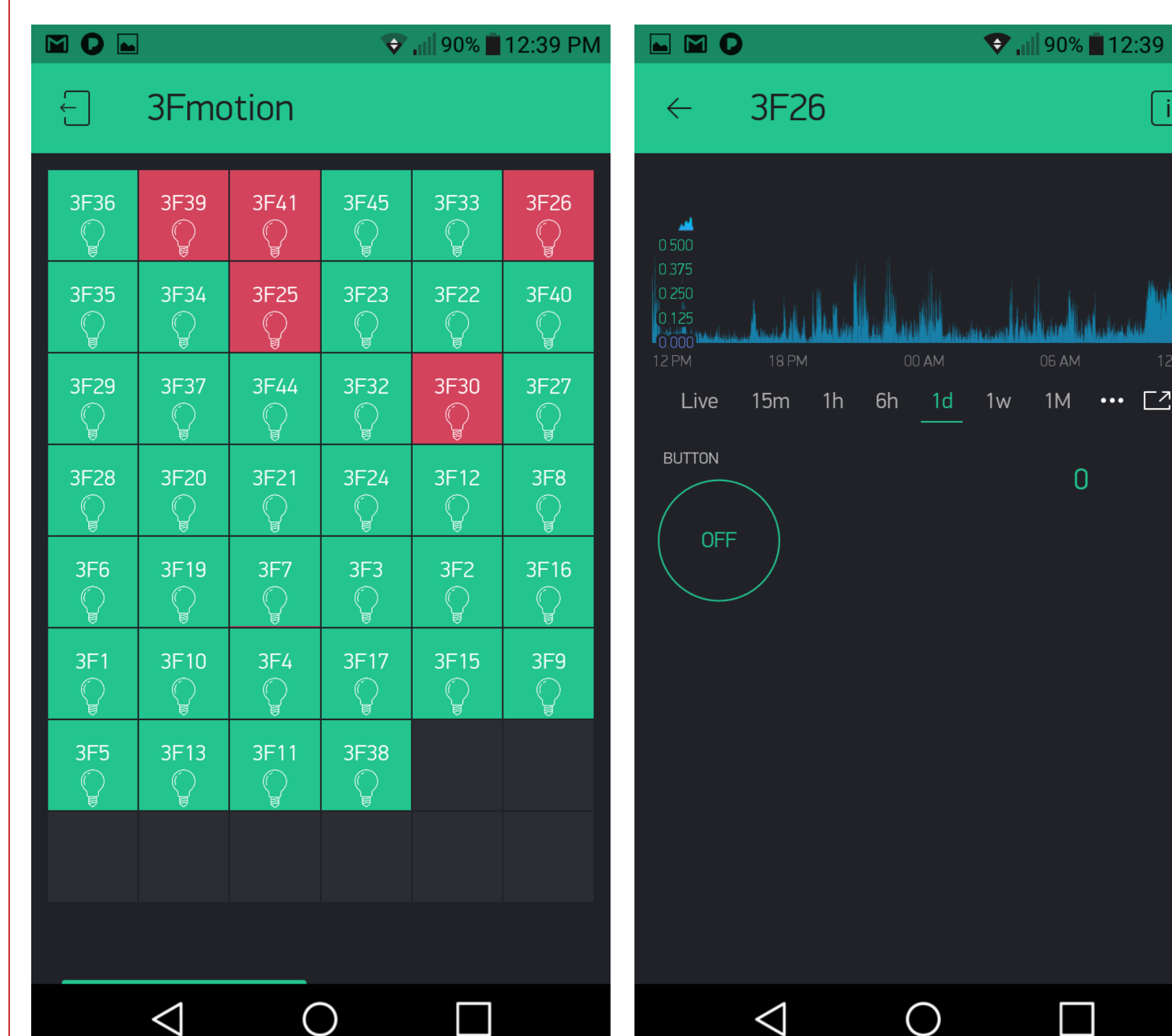
## 3D Modeling

3D models of the PCB, PCB enclosure, PIR enclosure, and the food hopper were designed using top-down design practices to prevent inconsistencies and ensure proper assembly. This design approach also ensured compatibility with the case hopper.



## Results

- MIOS prototype
- Real-time data uploads to a cloud-based server
- Blynk Application (custom) for Android and iPhone is used to monitor and analyze data
- MIOS beta studies with obesity research



## Future Plans

1. Redesign PCB to integrate sensors on the main PCB.
2. Integrate a battery gauge sensor.
3. Implement a method to detect water and food consumption.
4. Add behavior and learning study capabilities and analytics.
5. Use RFID tags for rodent identification and management.

<https://spis.cit.nih.gov/>

For More Information Visit Our Website

